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(57) Abstract

A computerized drawing system enables a set of schematic diagrams to be created and modified. Display information associated with a circuit is entered into a computer. The display information may include symbols, interconnections, and other information. A plurality of schematic layers are created from the display information and stored. A plurality of schematic configurations are then defined by a layer or by combining two or more layers together. Any given layer may be included in more than one configuration. The configurations are then stored for utilization during the design process. A user may modify one of the created layers. The system then automatically modifies each of the configurations which contain the modified layer. While a configuration is being displayed, a user may highlight information of the layers which is included in the displayed configuration.

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# METHODS AND APPARATUS FOR CONFIGURING SCHEMATIC DIAGRAMS

## FIELD OF THE INVENTION

The present invention is directed to methods and apparatus for developing schematic diagrams. More particularly, the present invention is directed to methods and apparatus for developing schematic diagrams by using a computerized system which allows a user to create and subsequently modify and extract information from a set of configurable schematics with computer-aided engineering applications.

## BACKGROUND OF THE INVENTION

The cost of designing and producing circuits is expensive. Accordingly, engineers need to ensure that the circuits they are designing function as desired. A number of computer applications have been developed which allow design engineers to test their circuits prior to actually incurring the cost of production. Some of these computer-aided engineering applications are based on "SPICE," which was first developed by the University of California at Berkeley and later refined by a number of institutions, including the Georgia Institute of Technology. The SPICE-based applications provide design engineers with the necessary tools to create, test, and simulate circuits on a computer.

Different levels or stages of the circuit design process require different schematic diagrams. For example, a design engineer may use a "closed-loop" schematic during a development stage, while a production engineer may use a "production" schematic. Further, a test engineer may create a number of schematics to test a circuit according to different sets of stimuli and load conditions. Although the schematics are associated with the same core circuit and may incorporate a number of the same components, each of the schematics will include a number of elements unique to that particular schematic incarnation.

A long-standing problem in electrical and mechanical circuit design is the conflict between the needs of the design engineer and the needs of the production

engineer. A design engineer uses electronic design automation (EDA) tools to create a circuit that meets desired specifications. During the design process, the design engineer builds multiple configurations of the circuit. The operation of the circuit is simulated, with parasitic components and stimuli added to modify the simulation. In a top-down design methodology, different levels of abstraction are inserted for different circuit components. In addition, various aspects of electrical behavior are modeled, resulting in different component and simulation configurations. This entire design process results in a schematic diagram which is confusingly cluttered and includes circuitry and data not necessary for production. When the circuit is finalized and ready for production, the schematic needs to be redrawn for or by the production engineer. The redrawing of the schematic is accompanied by a high probability of incurring a transcription error. Any error carried through to the production stage is extremely expensive and burdensome to correct. In addition, any change which is made to one component of the circuit needs to be propagated through all of the different schematics variations which contain that component; accordingly, each of the schematics needs to be re-edited which is expensive, time consuming, and inherent with a probability of error.

One of the conventional approaches to overcoming this problem has been to hide the many auxiliary configurations and variations of the circuit in "subcircuits." Although this approach may function for hierarchical schematic entry, or for extending individual component models, it does not solve the problem of adding test equipment to the circuit, adding different stimuli inputs, or dealing with multiple simulation scenarios.

Accordingly, in view of the foregoing, it is an object of the present invention to provide methods and apparatus which eliminate many of the drawbacks associated with conventional computer-aided engineering applications.

It is an additional object of the present invention to provide a computerized schematic drawing system which allows a user to create and modify a set of schematic diagrams for one or more designs and which substantially eliminates

errors and inconsistencies between multiple schematics associated with a common circuit.

## SUMMARY OF THE INVENTION

These and other objects are achieved by a computerized schematic drawing system of the present invention. The drawing system allows a user to create a set of schematic diagrams or "configurations." Each of the configurations may contain one or more schematic layers. Each of the layers may contain information intended to be displayed for viewing or processing. This information may include schematic symbols, interconnections between schematic symbols, and other associated information. The drawing system includes an input mechanism, a display, and processing hardware. The input mechanism may receive a number of different types of information, including the display information associated with each of the layers. The input mechanism may also receive information programmatically. The input mechanism also receives layer assignment information which specifies a layer to which the display information belongs, and configuration assignment information which specifies which layers it contains. In addition, the input mechanism may receive control information which specifies other functions of the drawing system. The display may selectively display the configurations and the layers when created and/or modified, if desired. The processing hardware manages all of the information received or generated by the input mechanism and causes the display to selectively display the configurations and the layers that are created.

One of the advantages of the present invention is that a user is able to modify one of the layers and automatically propagate the change throughout each of the configurations which contains the modified layer. This feature substantially eliminates transcription errors which may occur in conventional computer-aided engineering applications. Another advantage of the invention is that a user may selectively highlight any one of the layers which comprise a displayed configuration. This allows the user to graphically or visually determine the contents of each of the

layers within any of the configurations. It also allows a user to determine to which layer a particular component belongs.

Other aspects, features, and advantages of the present invention will become apparent to those persons having ordinary skill in the art to which the present invention pertains from the following description taken in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a computerized schematic drawing system in accordance with an exemplary embodiment of the present invention;

FIG. 2 is a block view of an exemplary embodiment of a computer of the drawing system of the invention;

FIG. 3 is a schematic view of an exemplary configuration displayed in a graphical user interface and created in accordance with the present invention;

FIG. 4 is a schematic view of exemplary configurations displayed in respective graphical user interfaces and created in accordance with the invention, particularly illustrating a common layer assigned to each of the different configurations; and

FIG. 5 is a flow chart illustrating an exemplary embodiment of operating methodology in accordance with the present invention.

## DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Referring more particularly to the drawings, FIG. 1 illustrates an exemplary embodiment of a computerized schematic drawing system **50** of the present invention. The exemplary drawing system **50** includes a computer **52**, a display **54**, an input mechanism such as a keyboard **56** and/or a trackball or a mouse **58**, and a printer **60**. FIG. 2 illustrates an exemplary embodiment of the computer **52** in which a processor **62** receives data from the input devices **56**, **58** and provides data to the display **54** and the printer **60**. The computer **52** may also include a drive, such as a floppy drive **64** or a CD-ROM drive **66**, in communication with the processor **62**.

The processor **62** may also be in communication with a computer network via a network interface card (not shown). The computer **52** may include memory **68** connected to the processor **62**. The term "processor" used herein refers to any hardware or circuitry for processing data, for example, a central processing unit (CPU).

The drawing system **50** enables a user to create, modify, extract data (i.e. netlist and other text and binary types of information) and print a set of schematic diagrams. An exemplary schematic diagram or configuration **70** is illustrated in FIG. 3. Schematic configuration **70*a*** (which is generally referenced with numeral **70** with an alpha specifier *a*) is shown in a graphical user interface (GUI) **72** displayed on the display **54**. Configuration **70*a*** is entitled "Closed Loop" as shown on a title bar **74** of the GUI **72**. Exemplary schematic configuration **70*a*** is composed of a plurality of schematic segments or layers generally indicated by reference numeral **76**. Each of the individual layers **76** also has a specific alpha, for example, **76*a*** and **76*c***. Each of the layers **76** contains a unique set of information or data. The set of information may include schematic symbols **78** representing circuit components, interconnections **80** between the schematic symbols **78**, and other optional associated information **82** such as component specifications, simulation directives including stimuli and loads, pictures, text, notes, graphs, and so on. The symbols **78**, the interconnections **80**, and the associated information **82** essentially comprise display information which may be entered via the hardware input devices **56** and/or **58** or programmatically via other software which interfaces with the present invention, which will be discussed below.

The schematic configuration **70** is a schematic diagram which contains circuit information for a variety of purposes. For example, a production engineer may need a schematic containing a particular set of information for his or her needs, while a test engineer may need another schematic containing another set of information. Accordingly, it is useful to have available a plurality of the layers **76** which may be combined together to form a plurality of schematic configurations **70**

each for a different purpose. This relationship between the schematic configurations **70** and the layers **76** is exemplified in TABLE I below.

**TABLE I**

| Configuration 70 / Layer 76 | Production (70*a*) | Component (70*b*) | Closed Loop (70*c*) | Open Loop (70*d*) | Safe to Start (70*e*) |
|---|---|---|---|---|---|
| Core Circuitry (76*a*) | X | | X | X | X |
| PWB Layout (76*b*) | X | | | | |
| Component Level (76*c*) | | X | | | |
| Feedback (76*d*) | | | X | | X |
| Test No. 1 (76*e*) | | | | X | X |
| Test No. 2 (76*f*) | | | | | X |
| Test No. 3 (76*g*) | | | X | | X |
| Safe Test (76*h*) | | | | | X |

With additional reference to FIG. 4, in the particular example of TABLE I, the design process of a circuit has resulted in a plurality of layers **76*a*–76*h*** each containing a unique set of symbols **78**, interconnections **80**, and associated data **82**. Each of the layers **76** may be created by inputting or setting up such display information into the computer **52** via the input devices **56** and/or **58**, or by other automated or manual means. This inputting mechanism is represented by step **S1** of the exemplary operating procedure of the present invention illustrated in FIG. 5. The data inputting step may be thought to involve entering assignment information into the processor **62** that specifies which layer **76** the display information **78**, **80**, **82** belongs to (step **S1*a***). Alternatively, the layers **76** may be downloaded via a network connection or the drives **64** and/or **66** (step **S1*b***) or set up programmatically by another software system (step **S1*c***). Each of the layers **76** may be assigned a name indicative of the information contained in the layer; for example, layer **76*a*** is entitled "Core Circuitry"; layer **76*b*** is entitled "Printed Wiring Board (PWB)

Layout"; and so on. After defining a number of layers **76** (step **S2**), the layers **76** may be stored in the memory **68** (step **S3**) of the computer **52**.

From the created layers **76*a*–76*h***, a plurality of configurations **70*a*–70*e*** may be defined (step **S4**), each of which may be assigned a name. The configurations **70** may be defined by entering configuration assignment information into the processor **62** that specifies which layers **76** are assigned to a particular configuration. Alternatively, configuration assignment information may specify each of the configurations **70** to which a particular layer **76*a*–76*h*** is assigned. Each of the configurations **70** contains one or more of the layers **76**. For example, configuration **70*a*** entitled "Production" (which is illustrated in FIG. 4) contains layers **76*a*** and **76*b***; configuration **70*b*** entitled "Component" contains layers **76*c***; configuration **70*c*** entitled "Closed Loop" (which is illustrated in FIGS. 3 and 4) contains layers **76*a***, **76*d***, and **76*g***; configuration **70*d*** entitled "Open Loop" (which is illustrated in FIG. 4) contains layers **76*a*** and **76*e***; and configuration **70*e*** entitled "Safe to Start" contains layers **76*a*** and **76*d*–76*h***. Accordingly, each configuration **70** contains a unique set of layers **76**, while any given layer **76** may be contained in more than one configuration **70**. For example, layer **76*c*** is contained in each of the configurations **70*a***, **70*c***, and **70*d*** illustrated in FIG. 4. Some of the layers **76** may not be included in any of the configurations **70**.

In creating the configurations **70**, the layers **76** may be combined in any manner. For example, the predefined layers **76** may be combined via the input devices while being indicatively displayed on the GUI **72**. The layers **76** may also be downloaded from a file stored on a hard disk, the drives **64** or **66**, or via the network connection. Alternatively, the layers **76** may be combined programmatically by other software applications to define the configurations **70**. For example, a software application may include instructions to combine certain predefined layers **76** into a particular configuration **70** without any user intervention via the input devices **56** and/or **58**. The configurations **70** may be stored (step **S5**) along with the layers **76** (including all of the information contained in each of the layers **76**) in a database in the memory **68** of the computer **52**.

The stored configurations **70** and layers **76** may be in the form of computer files that can be used by the computer **52** in conjunction with other computer programs or software applications or by another network computer. The software may utilize the stored configurations to produce one or more types of computer files or data in memory. The resulting computer files or data in memory is dependent on the particular configuration that is currently displayed. The computer files or data in memory may include SPICE netlists, binary files, data structures in the computer's memory or other types of information such as simulator netlists, EDIF netlists, OLE (object linking and embedding) methods and interfaces and so on. The information may be used by SPICE and other programs for other steps in the circuit design/manufacturing process such as layout, manufacturing, data transfer, simulation and so on. It is not necessary to display each of the configurations **70** or layers **76** on the display **54**. The configuration-dependent information may also include bill of material netlists, parts netlists, manufacturing/logistical netlists, printed circuit board (PCB) layout netlists, packaging/layout netlists, test and simulation results and report output summaries.

Once the configurations **70** and/or the layers **76** are stored, the netlists may be sent to or accessed by other programs for a variety of purposes. For example, a packaging/layout netlist may be sent to an application for producing integrated circuit (IC) masks or PWB drawings or boards. In addition, test results, which may include information derived from a simulation with specific stimuli and load conditions, may be viewed in a schematic program by a designer and used by other software to develop test-related software. A test report data may be accessed by an automatic test set program generator to control automatic test equipment. Each of these exemplary uses of the configurations **70** and layers **76** may be generally included in the representative output step **S6** of FIG. 5, with the specific production of these netlist files and data structures in the computer's memory represented by step **S6*a***. The output mechanisms of the layers **76** and the configurations **70** may also include a hard-copy output via the printer **60** (step **S6*b***) or a visual output via the display **54** (step **S6*c***).

Regarding the visual output mechanism in more detail, any number of configurations **70** may be output to the display **54**, as illustrated in FIG. 4, in which Production configuration **70*a***, Open Loop configuration **70*d***, and Closed Loop configuration **70*c*** are displayed in respective GUIs **72*a***, **72*c***, **72*d***. In this regard, a user may selectively highlight one of the layers **76** defined in the displayed configuration **70** (step **S7**). For example, as illustrated in FIG. 3, layer **76*c*** (the Component Level layer) is highlighted in the displayed Closed Loop configuration **70*c***. This highlight feature may be activated, for example, by a user pointing and clicking with the mouse **58** on any display data **78**, **80**, or **82** assigned to the layer **76** to be highlighted, or by using a special highlight feature. The highlighted layer **76*c*** allows a user to see all of the symbols **78**, interconnections **80**, and/or associated information **82** that are assigned to the layer. The highlighting also allows a user to determine to which layer a particular component of the circuit belongs (with the component being represented by data **78**, **80**, and/or **82**). The highlighted layer **76** is preferably highlighted by surrounding the layer by a color or superimposing color around the display information of the layer, causing the layer to stand out against the remaining portions of the GUI **72**. Other highlighting techniques may be used.

After viewing a particular configuration **70** or layer **76**, a design engineer may want to change a particular aspect or component of the circuit. If the engineer desires to make a change in one of the layers **76**, the layer **76** to be changed is displayed (step **S8**). The engineer may access a particular configuration **70** and, subsequently, a particular layer **76** by using a tool bar **84**, and may then make a change to the layer **76** via the input devices **56** and/or **58** (step **S9**). The change may entail adding data (i.e., symbols **78**, interconnections **80**, and/or associated information **82**) to, deleting data from, or modifying existing data of the layer **76**. After making the change, the modified layer **76** may be stored in the memory **68** (step **S10**). The processor **62** may then propagate the change in each of the configurations **70** which contain the modified layer **76**. This procedure of modifying layers **76** may continue throughout the design process. The modification procedure may involve cutting and pasting or moving data from one layer to another. The

propagation of changes throughout configurations **70** with a common modified layer **76** substantially eliminates the possibility of transcription errors between configurations **70**. In addition, the user will not have to manually open and modify each configuration **70** containing the layer **76** in which the change is to be made. The automatic propagation of the change may be manually activated by the user or may be activated upon resaving of the changed layer **76** (step **S10**) in the database in the memory **68**.

The above-described procedure and the flow diagram outlined in FIG. 5 are illustrative of exemplary methodology of the present invention. However, the methodology of the present invention is highly versatile and is not limited to that specifically shown. For example, layers may be created and configurations may be defined at any point in the design process. The input of data as represented by step **S1** (including symbols, interconnections, part information, simulation-related information, etc.) and the output of data as represented by step **S6** (including netlists, simulation results, printouts, pictures, etc.) may occur at any point. The modification of any of the data defining the layers/configurations may also be done at any time in the process. Accordingly, the scope of the present invention is not limited to that specifically shown and described.

The computer **52** preferably maintains a list of created layers **76** and defined configurations **70**, each with an identifying name. This list of layers/configurations may be made available to the user, for example, in the tool bar **84** shown in FIG. 4, or by other means. In addition, a user may add (as associated data **82**) to a number of layers **76** signal generators which generate respective signal responses of the circuit. The simulated or measured response may be in the form of a graph or a table of data. For example, as exemplified in TABLE I, each of the Test layers **76*e*–76*g*** may include a different signal generator which tests the circuit according to different parameters. The graphic response of the simulation or measurement may be added to a layer **76** or reside on its own layer. The design engineer may also add textual or graphical annotations as part of the optional data **82** to a layer **76**.

The methods of the present invention may be provided to a user in the form of computer code stored on a computer-readable storage medium, such as a floppy disk **86** or a compact-disc read only memory (CD-ROM) **88**, as shown in FIG. 1, or, alternatively, provided via the network connections as shown in FIG. 2. The storage medium **86** or **88** may be accessed via the drives **64** or **66**, respectively, and stored on the internal hard disk of the computer **52** (not shown). The storage medium **86** or **88** contains a set of computer-readable instructions which cause the computer system **50** to function in response to information entered into the system **50** via the input devices **56** and **58**.

Those skilled in the art will understand that the embodiments of the present invention described above exemplify the principles of the invention and do not limit the scope of the invention to those embodiments of the invention specifically illustrated in the drawings and described above. The exemplary embodiments provide a foundation from which numerous alternatives and modifications may be made, which alternatives and modifications are also within the scope of the present invention as defined in the appended claims. With reference to the following claims, unless the claims specifically use language directed to a "means" for performing a particular function, the claims are not intended to be limited to the structure specifically described and illustrated herein, but rather shall be construed to embrace all corresponding structure and equivalents thereof.

## CLAIMS

What is claimed is:

1. A computerized schematic drawing system for creating a set of schematic configurations each containing one or more schematic layers, each layer containing display information including schematic symbols, interconnections between schematic symbols, and other optional information, said computerized schematic drawing system comprising:

a. an input mechanism for receiving:

(1) the display information and modifications thereto;

(2) layer assignment information specifying the layer to which the display information belongs and modifications thereto;

(3) configuration assignment information specifying each of the configurations to which each layer belongs and modifications thereto; and

(4) control information specifying other functions of the drawing system;

b. a display for selectively displaying the configurations and the layers when created and modified; and

c. processing hardware connected to said input mechanism and said display for receiving the display information, the layer assignment information, the configuration assignment information, and the control information, for storing the display information, the layer assignment information, and the configuration assignment information, for causing said display to selectively display the configurations and the layers that are created and modified in conformance with this information.

2. A computerized schematic drawing system as claimed in claim 1 wherein:

said input mechanism receives information for modifying one of the layers; and

said processing circuitry automatically modifies each of the configurations to which the layer that has been modified belongs.

3. A computerized schematic drawing system as claimed in claim 2 wherein the information received for modifying one of the layers includes moving display information from one layer and to another layer.

4. A computerized schematic drawing system as claimed in claim 1 wherein said input device receives information for causing said processor to highlight a selected layer of a displayed configuration.

5. A computerized schematic drawing system as claimed in claim 4 wherein said processor highlights the display information of the selected layers by superimposing color around the display information specifying the selected layer.

6. A computerized schematic drawing system as claimed in claim 1 wherein said processing circuitry maintains a list of created layers and defined configurations.

7. A computerized schematic drawing system as claimed in claim 1 wherein said input device receives display information indicative of stimuli and simulated responses.

8. A computerized schematic drawing system as claimed in claim 1 wherein at least one of the layers is assigned to at least two of the configurations.

9. A computerized schematic drawing system as claimed in claim 1 wherein at least one of the layers is unassigned to any of the configurations.

**10.** A computerized schematic drawing system as claimed in claim **1** wherein said input mechanism includes a hardware device.

**11.** A computerized schematic drawing system as claimed in claim **1** further comprising a printer connected to said processing hardware;

said processing hardware for causing said printer to selectively print the configurations and modifications thereto in conformance with the control information.

**12.** A computerized schematic drawing method for creating a set of schematic configurations each containing one or more schematic layers, each layer containing display information, including schematic symbols, interconnections between schematic symbols, and other optional information, said method comprising the steps of:

a. receiving via an input mechanism:

(1) the display information and modifications thereto;

(2) layer assignment information specifying the layer to which the display information belongs and modifications thereto;

(3) configuration assignment information specifying each configuration to which each layer belongs and modifications thereto, at least one of the layers being assigned to at least two of the drawings; and

(4) control information specifying other functions of the drawing system;

b. storing in a storage device the display information, layer assignment information and the configuration assignment information; and

c. selectively displaying on a display the configurations and the layers when created and modified.

**13**. A computerized schematic drawing method as claimed in claim **12** further comprising the steps of:

receiving via the input mechanism information for modifying one of the layers; and

automatically modifying each of the configurations to which the layer that has been modified belongs.

**14**. A computerized schematic drawing method as claimed in claim **12** further comprising the steps of:

receiving via the input mechanism information for displaying a configuration with a selected layer thereof highlighted; and

displaying the configuration with the selected layer highlighted.

**15**. A computerized schematic drawing system as claimed in claim **12** wherein said processor maintains a list of created layers and defined configurations.

**16**. A computer-readable storage medium containing a set of computer-readable instructions for causing a computer containing an input mechanism, a display, and a storage device to create a set of schematic configurations each containing one or more schematic layers, each layer containing display information, including schematic symbols, interconnections between schematic symbols, and other optional information, in accordance with the following steps:

a. receiving via the input mechanism:

(1) the display information and modifications thereto;

(2) layer assignment information specifying the layer to which the display information belongs and modifications thereto;

(3) configuration assignment information specifying each configuration to which each layer belongs and modifications thereto; and

(4) control information specifying other functions of the drawing system;

b. storing in a storage device the display information, layer assignment information and the configuration assignment information; and

c. selectively displaying on a display the configurations and the layers as they are created and modified.

**17**. A computer-readable storage medium as claimed in claim **16** wherein said set of computer-readable instructions further causes the computer to:

receive via the input mechanism information for modifying one of the layers; and

automatically modify each of the configurations to which the layer that has been modified belongs.

**18**. A computer-readable storage medium as claimed in claim **16** wherein said set of computer-readable instructions further causes the computer to:

receive via the input mechanism information for displaying a configuration with a selected layer thereof highlighted; and

display the configuration with the selected layer highlighted.

**19**. A computerized schematic drawing system for creating a set of schematic configurations each containing one or more schematic layers, each layer containing display information including schematic symbols, interconnections between schematic symbols, and other optional information, said computerized schematic drawing system comprising:

a. input means for receiving:

(1) the display information and modifications thereto;

(2) layer assignment information specifying the layer to which the display information belongs and modifications thereto;

(3) configuration assignment information specifying each of the

configurations to which each layer belongs and modifications thereto; and

(4) control information specifying other functions of the drawing system;

b. display means for selectively displaying the configurations and the layers when created and modified; and

c. processing means connected to said input mechanism and said display for receiving the display information, the layer assignment information, the configuration assignment information, and the control information, for storing the display information, the layer assignment information, and the configuration assignment information, for causing said display to selectively display the configurations and the layers that are created and modified in conformance with this information.

**20**. A computerized schematic drawing system as claimed in claim **19** wherein said input means includes a hardware device.

**21**. A computerized schematic drawing system as claimed in claim **19** wherein said processing means includes a central processing unit.

**22**. A computerized schematic drawing system as claimed in claim **19** further comprising printing means connected to said processing means for selectively printing the configurations.

**23**. A computerized schematic drawing system as claimed in claim **19** wherein said input means includes a hardware device.

FIG. 1

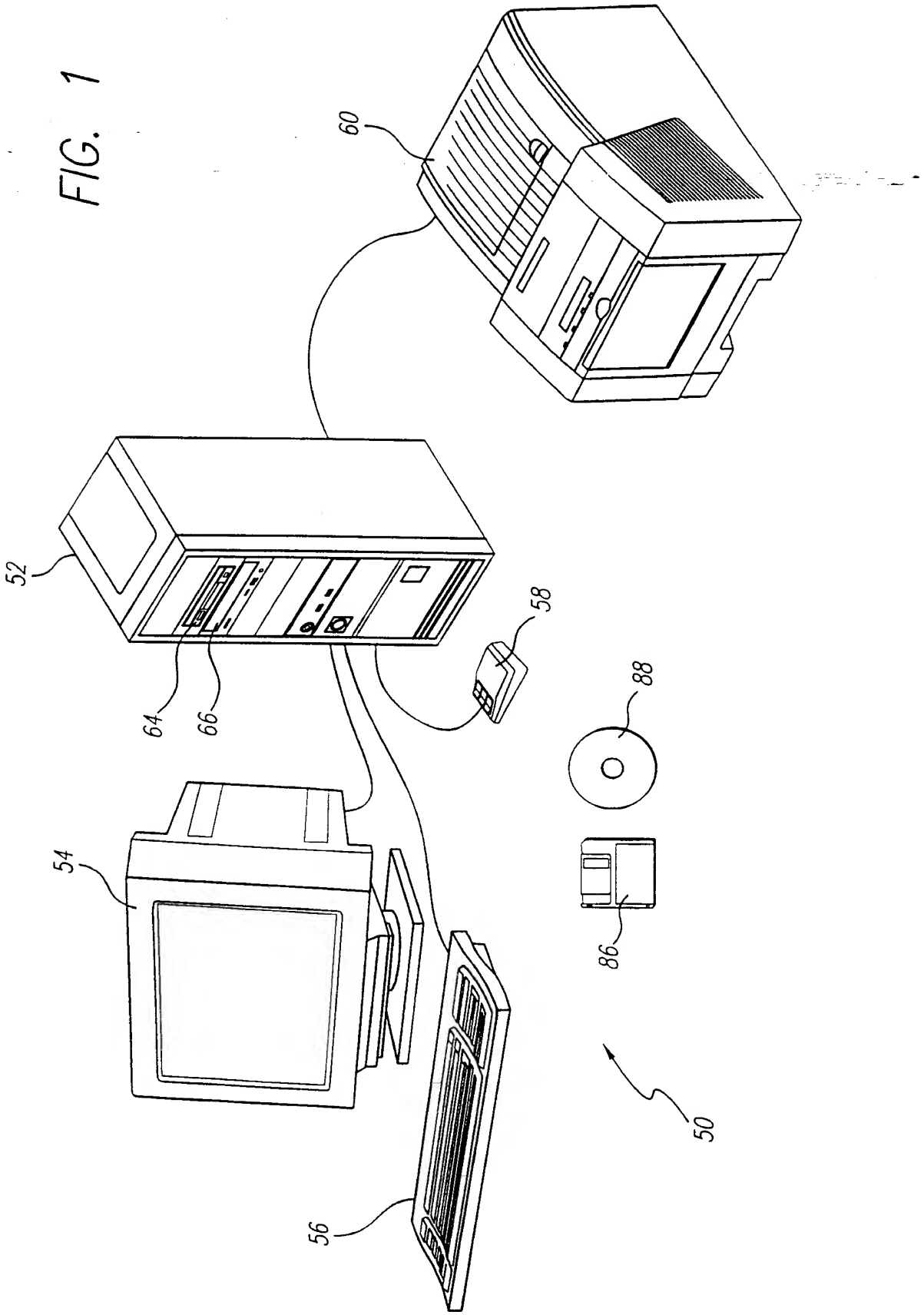


FIG. 2

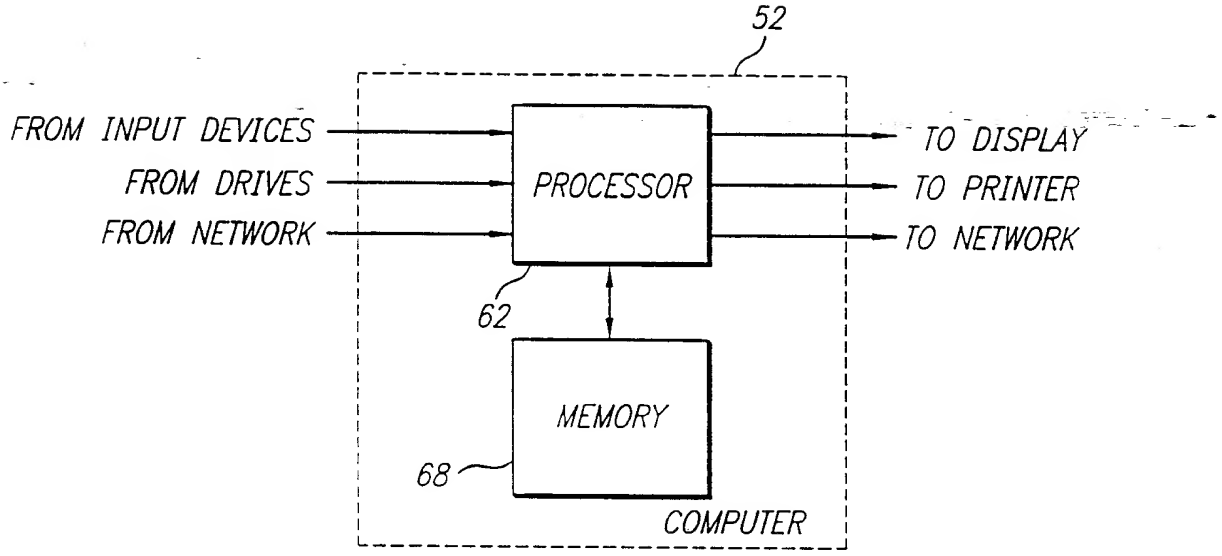

52
FROM INPUT DEVICES
FROM DRIVES
FROM NETWORK
PROCESSOR
TO DISPLAY
TO PRINTER
TO NETWORK
62
MEMORY
68
COMPUTER

FIG. 3

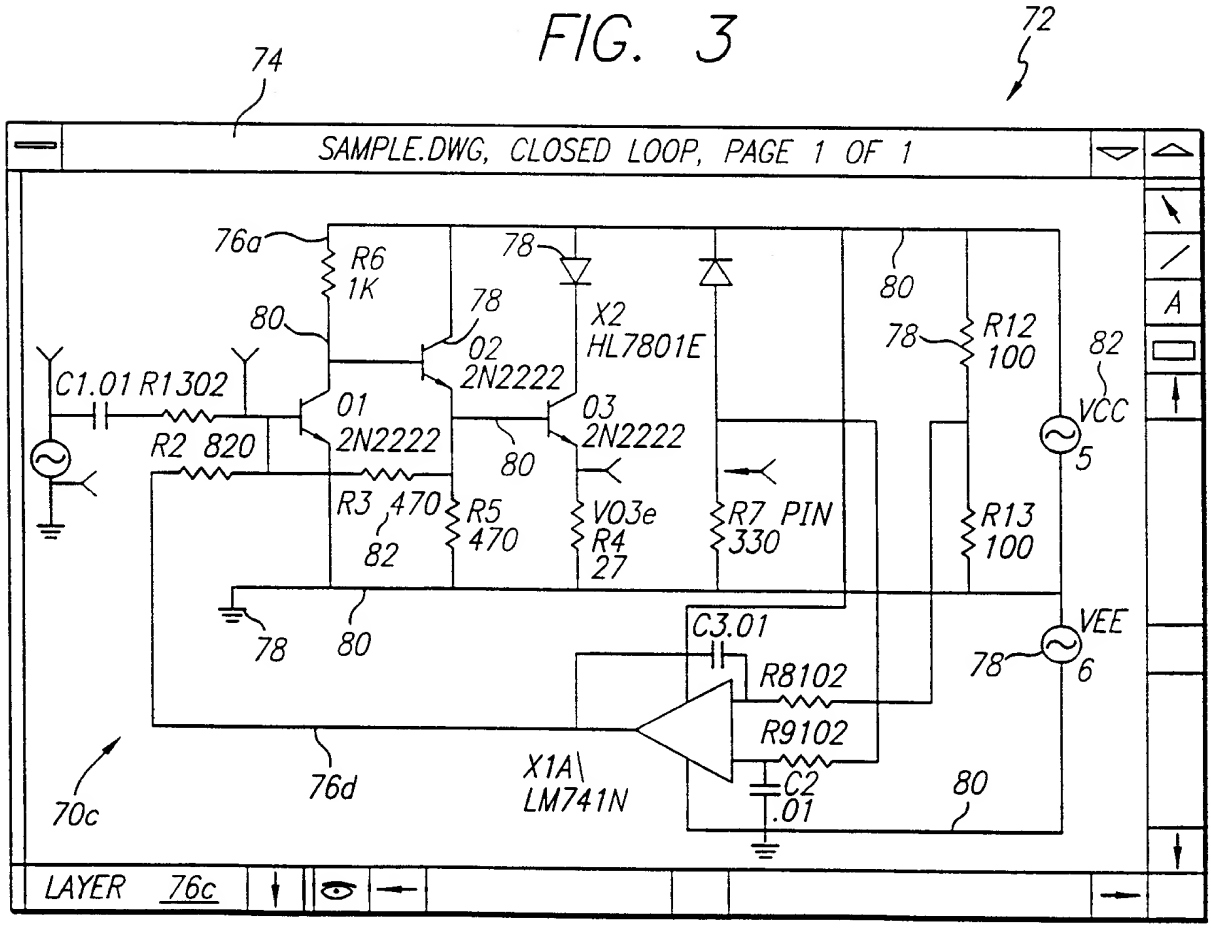
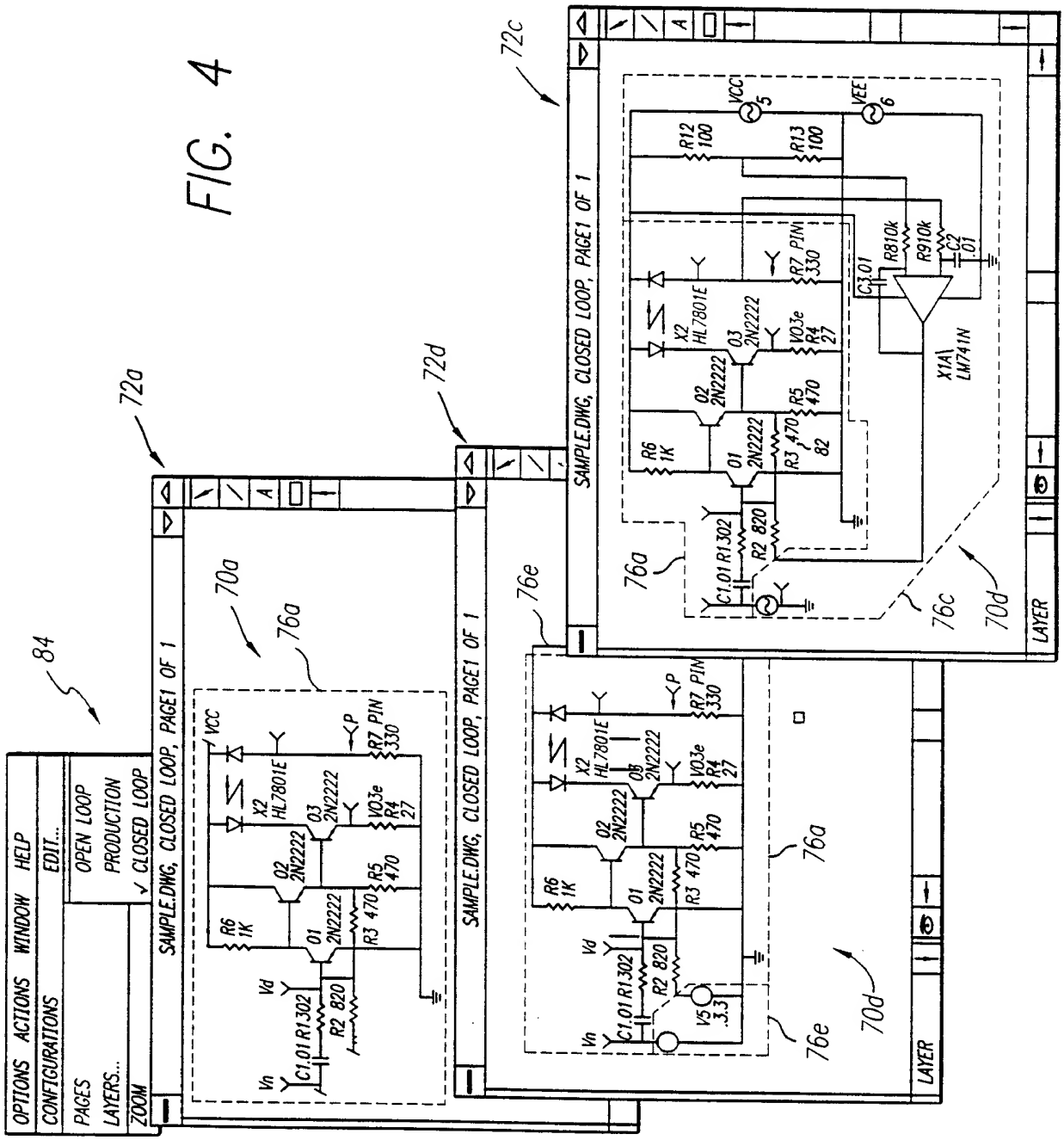

72
74
SAMPLE.DWG, CLOSED LOOP, PAGE 1 OF 1
76a
R6
1K
78
X2
HL7801E
80
78
R12
100
82
VCC
5
C1.01 R1302
01
2N2222
02
2N2222
03
2N2222
R2 820
R3 470
82
R5
470
VO3e
R4
27
R7 PIN
330
R13
100
78
80
C3.01
R8102
R9102
VEE
6
78
X1A\
LM741N
C2
.01
80
70c
76d
LAYER 76c

FIG. 4


84
OPTIONS ACTIONS WINDOW HELP
CONFIGURATIONS EDIT...
PAGES OPEN LOOP
LAYERS... PRODUCTION
ZOOM ✓ CLOSED LOOP
72a
72d
72c
SAMPLE.DWG, CLOSED LOOP, PAGE1 OF 1
70a
76a
76e
76c
70d
LAYER
VCC
VEE
X2 HL7801E
Q1 2N2222
Q2 2N2222
Q3 2N2222
R1 1302
R2 820
R3 470
R4 27
R5 470
R6 1K
R7 PIN 330
R12 100
R13 100
R810k
R910k
C1.01
C2 .01
C3.01
X1A LM741N
V5 3.3
Vd
Vn
P

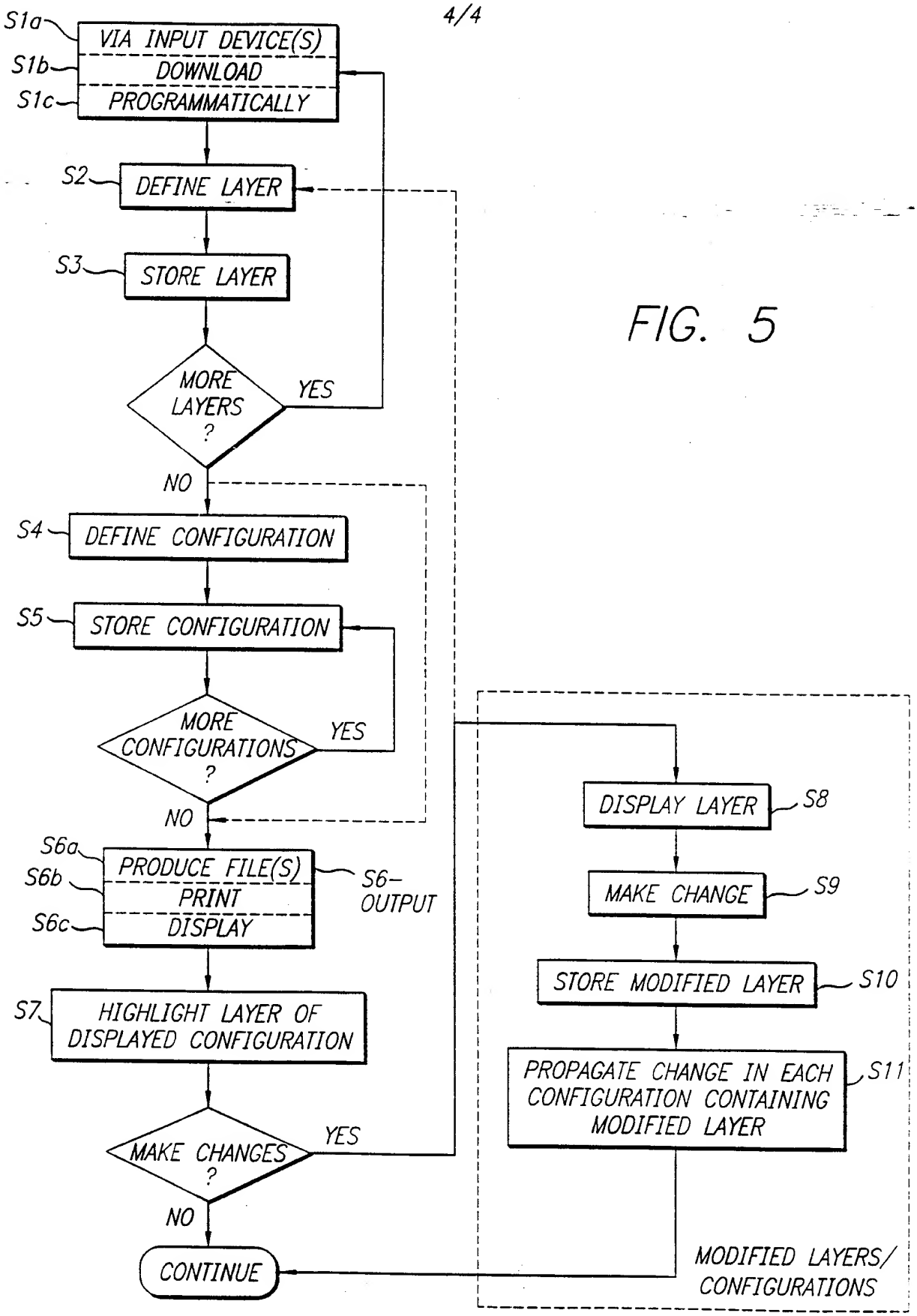

S1a
VIA INPUT DEVICE(S)
S1b
DOWNLOAD
S1c
PROGRAMMATICALLY
S2
DEFINE LAYER
S3
STORE LAYER
MORE LAYERS ?
YES
NO
S4
DEFINE CONFIGURATION
S5
STORE CONFIGURATION
MORE CONFIGURATIONS ?
YES
NO
S6a
S6b
S6c
PRODUCE FILE(S)
PRINT
DISPLAY
S6-OUTPUT
S7
HIGHLIGHT LAYER OF DISPLAYED CONFIGURATION
MAKE CHANGES ?
YES
NO
CONTINUE
DISPLAY LAYER
S8
MAKE CHANGE
S9
STORE MODIFIED LAYER
S10
PROPAGATE CHANGE IN EACH CONFIGURATION CONTAINING MODIFIED LAYER
S11
MODIFIED LAYERS/ CONFIGURATIONS

FIG. 5